A Step by Step Approach to Building an Internet Service Provider Network

An Honors Thesis (Honrs 499)

By

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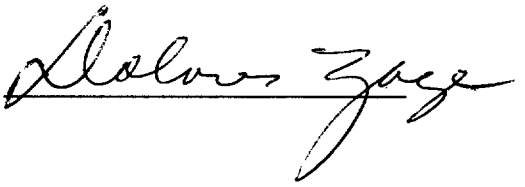

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Purpose of Thesis

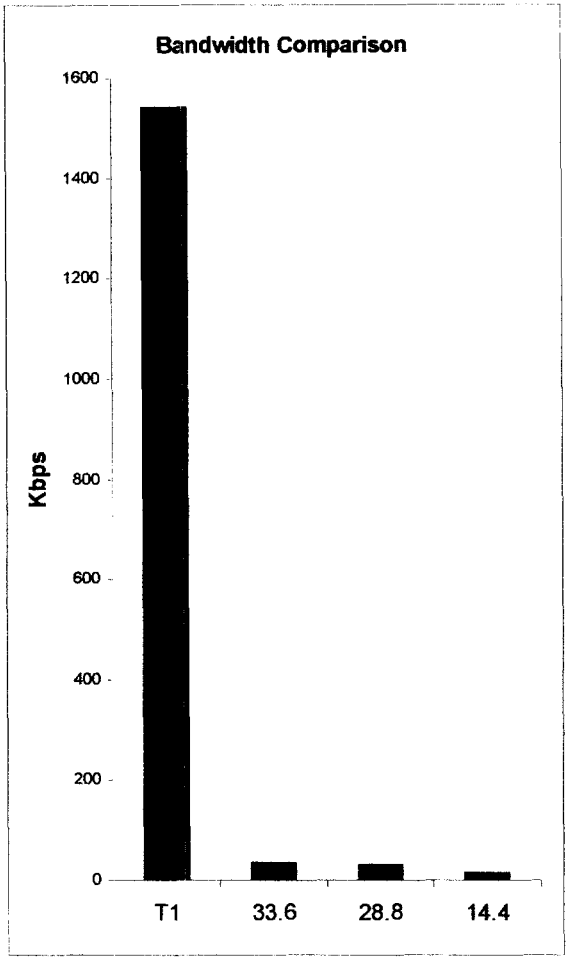
With the proliferation of the Internet in universities, businesses and homes, the question of where to get Internet service has become an ever-present question. The purpose of this paper is to give step by step instructions on designing and building a computer network centered on providing dial-up Internet access for a pool of users at a small university or company. My motivation to write on this topic comes from personal experience in this area. After many hours of research, I was not able to find much published material on this specific topic. I found that each ISP (Internet Service Provider) was left to make their own path and *reinvent the wheel* in many cases because there was no manual or written record of anyone else's experience widely available. This was my experience as I recently endeavored to create a network for this purpose.

This paper will begin with a description of the connection to the Internet necessary for a network with this purpose, and the bandwidth needed to support it. This will lead to a section on equipment needed for this network, followed by a description of the software needed to support the network, host web sites and handle services such as e-mail and domain name service. Finally it will conclude with a brief overview of installation and setup of all necessary equipment and software.

Part I "Systems Requirements"

Bandwidth and Internet Service:

The first step in building a dial-up Internet Service Provider (ISP) is examining the need and demand for Internet bandwidth to support your network. Bandwidth is the capacity that a telecommunications medium has for carrying data. When venturing into this realm of network planning, you will be confronted with technical terms such as T1 and T3. These are just names for different bandwidth Internet connections. To put some scale on them, most people are familiar with bandwidth in terms of the modem connected to their home computers. These modems are often 14.4kbps, 28.8kbps or 33.6kbps, where kbps stands for kilobytes of data per second describing transfer rate. T1 and T3 are larger connections to the Internet that have transfer rates of 1540kbps and 45000kbps respectively. As can be seen in the diagram to the left, the T1 provides much more bandwidth than the standard modems connected to our home computers. The T3, which is not shown, is about 30 times greater in bandwidth than the T1. (Mace, 1996)



The next step in building an ISP network is deciding on which connection will be required to support your network. The T1 is suited to support up to 200 concurrent web

surfers that are using 28.8kbps modems. This is based on the assumption that when surfing the Internet, one is not constantly downloading at the maximum available rate. This seems to be a reasonable assumption since much of the time spent by web surfers is reading the content of web pages.

The T3 connection can handle about thirty times as much traffic as the T1 and is generally required for more complex networks that provide service such as Integrated Services Digital Network (ISDN) and static Internet connections. These topics do not fall within the scope of this paper and will not be discussed.

Upon evaluating the requirements of most Internet service providers, I have concluded that a T1 connection is the one that will best fulfill the demand. There are other solutions for smaller demand such as fractional T1's, and Frame Relay connections. These, however, are not always as cost efficient and do not have the availability of the full T1. As a result, this paper will continue on the premise that this network will be built upon a T1 connection.

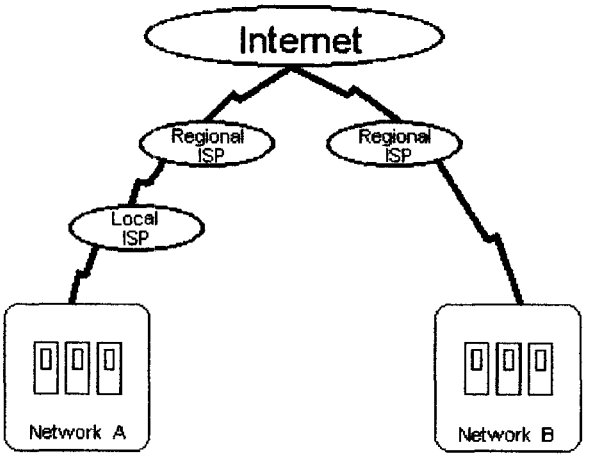
The next step is deciding on who to lease this Internet connection from. If you do not get a reliable connection to the Internet, your network will be plagued with technical problems and poor service will be rendered to your dial-up users. All will probably agree that this is unacceptable. Therefore certain issues should be addressed when choosing a provider. (Rigney, 1996)

The first and foremost issue is one of guaranteed maximum bandwidth that you have purchased. These days it is becoming more common for smaller regional ISP's to sell T1's to local ISP's and the result is watered down bandwidth. Watered down bandwidth occurs when your Internet connection is fed by an inadequate connection at

the suppliers site. This happens as result of the supplying company using their T1 to the Internet to provide several T1's to smaller companies.

Now, if you are thoroughly confused, let me clear this up for you. The above situation is analogous to having a 10-inch water pipe running into your house. You decide that you want to make money by selling water to your five neighbors, so you lease each one a 10-inch water pipe. All five are connected to your one, therefore it is not possible for each to get the total amount of water that their pipe can handle. This is effectively the situation that is taking place among ISP's. To avoid this situation, make sure that your contract ensures that you will be provided maximum bandwidth, and if possible inquire as to how you can keep track or measure the traffic on your connection.

Another important consideration is the number of "hops" from the Internet that your network will be. The number of hops is the number of physical connections, or routers that your network's data will have to cross to get to the Internet backbone. The fewer the hops, the faster and more reliable your connection will be. For example, Network A in the figure to the left is two hops from the Internet while Network B is only one hop away. The configuration of Network B is preferable. Like watered down bandwidth, multiple hops can be associated with smaller regional ISP's reselling bandwidth. (Martin, 1997)



This question of bandwidth and connection reliability is only the first concern in deciding your provider. The next question is one of technical support. If your line goes down in a storm, how fast will the supplier be out to fix it? If your provider is having troubles, does their technical staff have twenty-four hour schedules? Is your connection on a local loop so that if the connection is broken in one location, it will continue to be supplied at the other end? These are imperative questions that you should ask before signing an agreement with a regional ISP. These connections are very costly, so you will want to make sure that you are getting the most for your money.

The last consideration to be made concerns what is called a Class C license and domain name. A Class C license is a group of 256 IP network addresses from XXX.XXX.XXX.0 to XXX.XXX.XXX.255. The XXX.XXX.XXX section of the address is assigned by the regional ISP. The last octet, or three digits from 0 to 255, is assigned at your discretion. You will need these addressing capabilities so that the rest of the Internet will recognize the computers in your network. Most regional ISP's include this as part of the package when purchasing a large static Internet connection. (Albitz, 1992)

The domain name is the Uniform Resource Locator (URL) or friendly name that will connect people to your web site. (*www.yourcompany.com*) This cannot be determined arbitrarily, but must be cross referenced to make sure that it is unique. Most large ISP's handle both of these issues for you, but it is important that you know of their necessity. If your ISP does not take care of your domain name registration, refer to Appendix A for further instruction.

To make you search a little simpler, you would be best to narrow your choices to the large phone and cable companies such as AT&T, MCI, Sprint and Time Warner. These companies are the major Internet Service Providers for smaller local ISP's. They will best be able to fulfill your needs, and will not be a cause for as much concern as smaller providers can be. (Rigney, 1996)

Hardware:

After making the decision on your service provider, you will need to purchase the hardware for your network. The logical starting point is to choose the computers that will be your file servers. These computers will make up the foundation of your ISP network. The reliability of these systems will determine the reliability of your entire Local Area Network (LAN).

The most important software components for an ISP are the following: web server, mail server, and news server. I would recommend three separate machines to run these software packages. Other packages such as Domain Name Service (DNS) and Remote Access Dial Up Security (RADIUS), which will be discussed later, can run as secondary processes on these three machines. The best pairing will be the web server on its own machine, the mail server and DNS on a second machine, and the news server and RADIUS on the third.

Presently, the rate of change in hardware technology is astounding. It seems as though a system bought today is obsolete in less than a year. As a result of this rapid growth in the computer hardware industry, my best recommendation is to buy as big as possible now so as to avoid upgrade necessity in the near future. This will be a decision that will need to be made based on finances, but I think that my method will benefit the network greatly. It will alleviate short-term upgrades and the down time required to make them.

There are many manufacturers that make a Central Processing Unit (CPU) that can support this type of network, including AMD, Digital, Intel, Motorola, and Sun. I suggest basing all of the servers on the Intel Pentium Pro processor for reasons of

software compatibility and price. This processor is very well suited for powering servers running the 32bit operating system Windows NT. Windows NT, as will be discussed in a later section, will be the operating system chosen for this application.

The next important consideration will be both temporary and permanent storage. For system Random Access Memory (RAM), I would suggest no less than 64 megabytes of Error Correction Code (ECC) Extended Data Out (EDO) RAM per machine. This should be sufficient to handle user growth in the near future. Also, this will allow the whole DNS cache to be stored in RAM which will make name conversions much quicker. (Mace, 1996)

If you are planning to have several hundreds of users, their mail will pile up quickly requiring large amounts of permanent storage. This same situation can occur with the news server as more and more newsgroups are posted. The web server is not immune to massive storage needs if you are intending to host web sites for businesses as well as personal pages. Many ISP's offer anywhere from 5 to 10 megabytes of disk space for a personal web page. This is relatively small in comparison with a corporate site containing several pages of advertising or an online catalog. As a result of the massive storage needs of an ISP network, I would recommend at least a 5 Gigabyte Fast SCSI2 hard drive for each machine. Using the SCSI interface will allow for faster disk access and will decrease CPU overhead. The SCSI interface also allows for increased storage add on of up to seven SCSI devices which will be very necessary if business goes well. (Stam, 1996)

Other important hardware to consider for the servers will be a tape backup system. Its provides a degree of security by archiving the hard drives for quick data

restoration in case of a system crash, or in the unlikely event of system hacking. A CD-ROM will be necessary to load most software packages. A 4X CD-ROM drive will suffice, however, a faster drive such as an 8X or 12X may save time for only a modest price increase. Both CD-ROM and tape backup drive should be SCSI devices so that they will operate off of the same interface as the hard drives.

Lastly, you will want to consider investing in Uninteruptible Power Supply (UPS) systems. UPS systems provide line conditioning, as well as surge protection. Most importantly though, they offer continuous power to the network in case of a power outage. They can also initiate an auto shutdown sequence and page the network administrator in the case of long-term power failure. This can prevent countless hours of file restoration and technical difficulties associated with an unexpected power failure and system power down. Many companies make excellent UPS systems including APC, Isobar, and Tripp Lite. My recommendation is to buy the UPS with the largest insurance policy to cover your equipment in case of power induced damage.

The next large hardware decision to be made will be the type of network that will best suit the needs of an ISP. There are many configurations such as Ethernet, token ring, and many others. The best suggestion will be a 100BaseTX Ethernet, because of its large bandwidth. Once again this is based on the idea of buying big up front to avoid near future upgrades. This will require a 100BaseTX network adapter for each of the three servers. I recommend that all of the adapters be 32 bit for enhanced network performance. A 100BaseTX network hub will be required to connect all of the servers to the network and to the outgoing hardware for the T1. Before purchasing any of the

networking hardware, I recommend looking at the Hardware Compatibility List (HCL) that is sent with Windows NT to ensure that you purchase compatible hardware.

Connecting your LAN to the Internet will require some very specialized hardware. The first and foremost piece of equipment will be the router. A hardware router is a self-contained unit that connects two networks together, in this case, your ISP network and the Internet. Data moves across the Internet in small packets of information. Each packet has a destination address that is checked by the router and then is sent to the correct network, or delivered to a client if the receiving client is local to that LAN. It distinguishes the difference between local network traffic and Internet traffic and makes sure that all information gets to its destination. It acts very much like the post office when given packages to ship.

Choosing a router is dependent upon the size of Internet connection that it will be connected to. In this case, it will need to be configured for a T1. The choice of router can be the determining factor for how difficult network setup will be. Several companies sell routers including Adtran, Cisco and Motorola. In the interest of simplicity, I recommend the Cisco 2501 router. This router comes preconfigured with its operating software and requires a minimum of setup in order to get up and running.

Another component that will be key in connecting to the Internet is the Channel Service Unit/Data Service Unit (CSU/DSU). The CSU/DSU connects the T1 to the router. The data flowing into the CSU/DSU is digital and is converted to be used with the analog network on the local side of the unit. (Pistritto, 1996)

Picking a reliable CSU/DSU will also greatly affect the performance and reliability of your network. More expensive CSU/DSU's have error-checking circuitry

that constantly checks your T1 connection and reports errors immediately. In some cases, the providing ISP can make small changes based on the loop tests and prevent larger problems from occurring. As with routers, several companies manufacture CSU/DSU's such as Adtran, Cisco and Motorola. For this network, I recommend a Motorola CSU/DSU for reasons of easy installation and low maintenance.

The last and possibly the most important piece of hardware necessary is the modem pool. In order to have dial-up access, it is necessary to have modems to answer the incoming calls. There are many ways to accomplish this, some more cost efficient than others. The best option will be to buy a self contained modem pool with terminal server, such as the NetServer8 or NetServer16 by USRobotics. These products integrate eight or sixteen V.Everything modems in a contained case with power supply and terminal server. The V.Everything modem is beneficial because it will connect with dial-in modems of varying speeds. This unit is made to plug directly into your LAN and it is self-supporting. As with my previous recommendations, I recommend this specific solution because of the ease of setup and maintenance of this particular product. The NetServer modem pools provides several services such as dynamic IP allocation, access security, and simple management, all of which will be discussed in greater detail in later chapters. When user growth occurs, additional NetServers can easily be added to increase the number of incoming phone connections.

Software:

In order to make all of the equipment that you have purchased worthwhile, you will need software to operate it. Start with the network operating system (OS). This provides a foundation to run all of your Internet software. There are several network operating systems available for this type of project such as UNIX, LINUX, OS/2, Microsoft Windows NT and others. My recommendation is Windows NT Server version 4.0. The reason for using NT is that it is easy to administer, it is very robust, and it is interoperable with all of the OS's listed above as well as others. The rest of this paper will be based on NT as the foundation of this ISP network.

After choosing the operating system, software packages for the e-mail server, DNS server, web server and news server will also need to be purchased. Once again, there are many software packages on the market from several companies like Microsoft, Netscape, MetaInfo, O'Reilly & Associates and others. You may choose to examine each more in depth before making a decision. In the remainder of this section, I will make recommendations for which software package to choose based on price, ease of use and performance.

The first package to choose will be the web server. The web server is the software that allows you to host a web site, ftp (file transfer protocol) site, and virtual domains. A virtual domain is where one would host another's web site and alias the name so that it appears to be on its own server. This is very popular among small and mid sized businesses that do not have a large enough budget to have their own equipment to host their own site, but can afford to pay for space on another.

For this network, I recommend Microsoft's IIS (Internet Information Server). IIS comes with the newest version of Windows NT and is available for download for older versions. IIS is simple to implement and administer. Setting up virtual domains and ftp sites is a simple task. Best of all, IIS is free, and when you consider the pricing on some of the other software, this is a welcome break.

Next we turn our attention to the DNS. The Internet works on a 32 bit addressing system that assigns computers and Internet sites addresses such as 147.226.110.241. DNS provides the support for Internet site names also known as URLs (Universal Resource Locator). It maps names like *www.yourcompany.com* to its corresponding 32 bit address and vise versa. The URL or friendly names are much easier to remember and are commonly seen in commercials, magazine advertisements and newspapers. (Albitz, 1992) For DNS software, I recommend a package called DNS by MetaInfo.

Next, we address the mail handling software. Two protocols that are standard in e-mail handling today are POP3 (Post Office Protocol 3) and SMTP (Simple Mail Transport Protocol). POP3 is used to transfer mail from the mail server to the user's computer and vise versa. SMTP is used to transfer mail between networks via the Internet. It uses conventions such as the DNS resolution to make sure that your mail gets to the right network mail server and ultimately to the intended reader. For e-mail software I recommend the software Sendmail with POP3 by MetaInfo.

Next we move on to the topic of the news server. Today there are thousands of public newsgroups. Many people use the newsgroups for leisure and work. In order to offer newsgroups to your dial-up clients, you will need a news server client that will accept the news from your ISP's news server. In effect it will set up a relay between your

customers and the Internet for posting and receiving news. I recommend Netscape's news server for this application.

Finally, we come to the selection of the RADIUS software. RADIUS is security for modem dial-in. The RADIUS software can be downloaded from the Internet for free as shareware. This version is a port from a freeware UNIX version. The alternative is to buy the commercially available Steel Belted RADIUS software package. The commercial package is expensive, but it is fully documented and installation is automated. The version on the Internet is not supported and has no documentation. I recommend the commercial version. The investment in support will be worth the money.

Shopping List:

Before proceeding with the setup, here is a recap on what needs to be purchased for the ISP network.

- Servers (3)

  Pentium Pro 200 w/512K Pipeline Burst Cache
  64 Megabytes of ECC EDO RAM
  5.0 Gigabyte SCSI2 Hard Drive
  4X SCSI CD-Rom Drive
  SCSI Tape Backup Drive
  100BaseTX PCI Ethernet Network Adapter Card
  SCSI2 Interface Adapter
  64 Bit Video Card
  Keyboard/Mouse/Monitor

- 100BaseTX Network Hub (1)

- UPS System 1400 watt (2)

- USRobotics NetServer16 Modem Pool (1)

- Cisco 2501 Router (1)

- Motorola CSU/DSU (1)

- Category 5 UTP Cables with RJ45 connectors (6 50 foot cables)

- Software

  Microsoft Windows NT Server 4.0 (3)
  MetaInfo DNS (1)
  MetaInfo SendMail (1)
  Netscape News Server (1)
  RADIUS (1)

Part II "Hardware Configuration and Setup"

Network Layout:

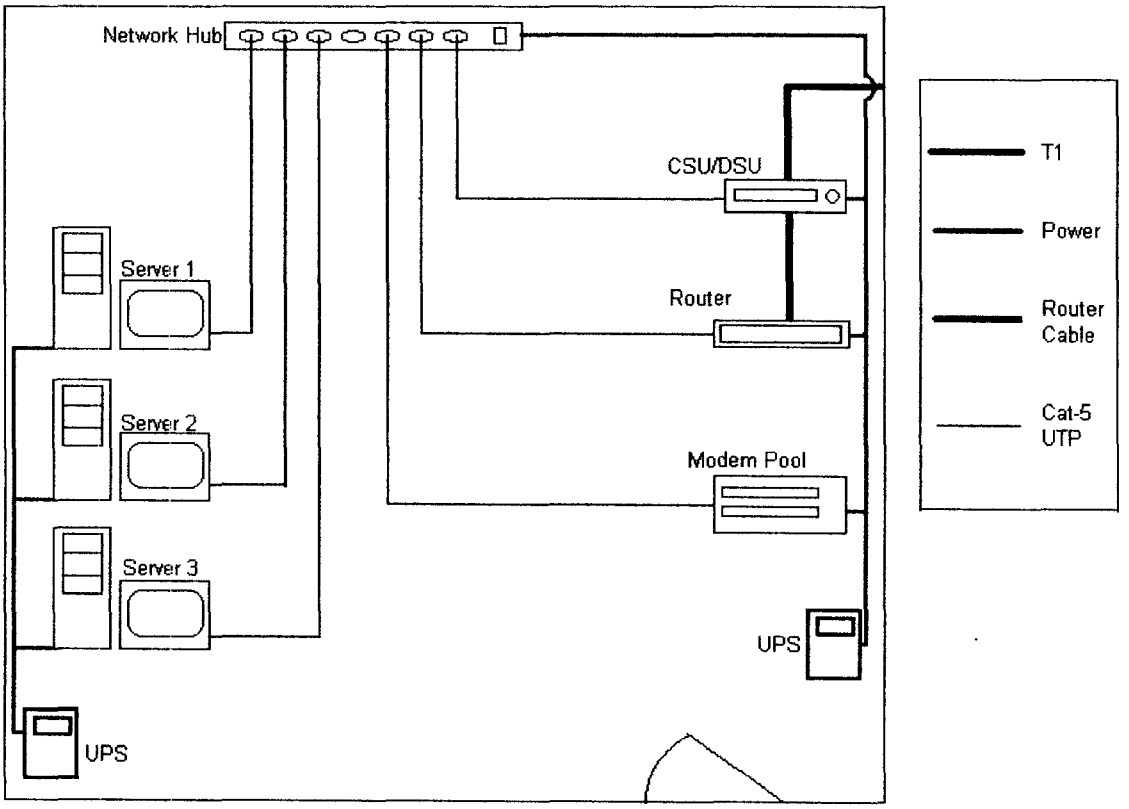
I am writing this next section from the viewpoint of the individual organizing and overseeing the setup of this network. As a result, it is more readable for a knowledgeable lay person and will leave the technical details to a trained technician.

The first and most important step in setting up any network is to lay it out on a diagram. When picking the location for the server room, there are some important issues that you will want to consider. This room should be well ventilated and preferably will have temperature control to avoid excess heat, which can damage some computer equipment. It should also have well-grounded wiring to provide a clean power source. Another consideration is that there be no large sources of EMI (Electromagnetic Interference) present or near the server room. Such sources are large fans or air conditioning systems.

Start your diagram with a floor plan for your office and pick the physical locations for the three servers. Make sure that the servers are located in a position that offers good airflow for ventilation. Next mark the point where the ISP will install your T1 connection. Also mark the location of the phone lines to be used for the modem pool.

Next, physically draw in the servers and pick a position to place a rack or shelf for the networking equipment such as CSU/DSU, router, network hub and modem pool. Then draw each of these in your diagram. Try to draw your diagram as accurately as possible so that if a person unfamiliar to your network needs to work on it, they would know the layout perfectly from reading your diagram.

You will need to plan for electrical outlets, phone lines and network connections as well. I will talk about wiring in detail in the next section, but keep in mind that all three servers, modem pool and router will each connect to the network hub. The T1 will connect to the CSU/DSU and that will connect to the router. Also, remember that all of your networking equipment, as well as the servers, need to be plugged into one of the UPS systems. Here is a sample diagram of a small ISP network.



Power Systems and Wiring:

Now that you have a good diagram of the layout of our network, you are ready to start assembling and connecting the hardware. Begin by actually setting the hardware in its place according to the diagram. Go ahead and connect all of the peripherals such as keyboard, mouse and monitor to each of the servers and get them ready to load software. Next, plug the power cords from the servers into one of the UPS units. (It is assumed that at this point you have read the UPS startup manual and charged the unit's batteries and it is ready for use.) We will use one UPS to service the three servers. The rest of the network equipment can be plugged into the second UPS. At this point, plug the network hub, modem pool, router and CSU/DSU into the second UPS.

Next you will connect each server into the network hub. You may opt to have your office wired by a professional with wall plates and hidden wire bundles. This is a preferred method, but it can be costly and out of the budget for a small network of this type. A useful alternative is to run the wires along the wall bundled together so they are not in danger of being tripped on or moved. Using this approach, you will take three strands of category 5 Unshielded Twisted Pair (UTP) cable with the RJ45 ends and plug one end into each server at the network card. Then bundle the wires together and run them to the network hub and plug the other three ends into any three open ports. It is helpful to tag each cable at each end and label where it is connected and where it originates.

Now that the servers are ready, move on to the Wide Area Network (WAN) equipment. First, start with the CSU/DSU and the router. The CSU/DSU will connect to the T1 via a cable that comes with your unit with an RJ45 plug at both ends. As far as

the router is concerned, connect it via the 35 pin cable from the CSU/DSU to the first serial port of two on the back of the router. The router then needs to be wired to the network by taking a strand of category 5 UTP cable and plugging it into the network port on the back of the router and into one of the network ports on the hub. Once again label the cable on each end.

Now you will hook up the modem pool. It will be connected via a UTP cable to the network. (By now I am sure you are labeling all of your connections). The phone lines can be connected from the wall block to the back of the modem pool. It is helpful to label even these cables to make any phone line troubleshooting easier in the future. It is a good idea to start a file with the wiring diagram and a list of the connection labels that you made on the Ethernet and phone cables.

Part III "Software Installation and Setup"

Windows NT Installation:

Now that the hardware is setup and connected physically, it is time to install the software that will run the network. You will begin by installing Windows NT Server on each of the three servers. Before you start, it will be important to do a little preplanning so that the installation goes smoothly.

I addressed the topic on DNS earlier in the paper and how it serves to map friendly names to 32 bit addresses used by the Internet. When installing and setting up the network, names and addresses need to be assigned to the servers so that the Internet can access them. When purchasing the T1 connection to the Internet, the supplying company also provided a Class C license and 255 network addresses that will be unique to this network. These addresses will be XXX.XXX.XXX.0 through XXX.XXX.XXX.255 where XXX.XXX.XXX denotes the actual address assigned to the network.

You now need to label the first server the Web Server, the second as News Server and the third as Mail Server. You also need to give each of these computers a name. It can be whatever you choose, but remember that this name is how the rest of the Internet will see your computers. For this network I will call the Web Server "WEB", the Mail Server "MAIL" and the News Server "NEWS".

Next, assign a 32 bit address to each server. Start with XXX.XXX.XXX.2 for WEB, XXX.XXX.XXX.3 for MAIL and XXX.XXX.XXX.4 for NEWS. Write down this information, as it will be needed when installing software. Now, the router and modem pool need names and addresses also. Again, you are free to choose names. I will use

"ROUTER" for the router and "MODEM" for the modem pool. The addresses will be XXX.XXX.XXX.1 for the router and XXX.XXX.XXX.5 for the modem pool. Write this information down, as it will be needed when installing software.

At this point, I will refer you to the Windows NT Installation Manual for the details of installation for Windows NT. I will only cover the section dealing with the networking setups.

Assuming that you have reached the point of network setup, the following steps need to be taken. You need to give your computer the name that you have chosen when prompted. Next, NT will prompt you for protocol selection for the network. For our purposes, it is only necessary to install the TCP/IP protocol. NT will then require you to enter the 32 bit address for this computer along with the gateway that this network will be using. Enter the address that was assigned above for the computer. For the gateway, enter the address of the router. The router serves as the gateway from the LAN to the Internet.

Upon entering all of the information above and following the installation manual, Windows NT will reboot. All three of the servers should now be running. After logging on as the administrator, you should be able to test the network by clicking on the network icon. In the window that opens, there should be icons for each of the three computers with the names beside them. If you see this, you are ready to proceed. If not, read the network troubleshooting section in the Windows NT manual.

Network Configuration:

The next task will be configuring the rest of the LAN equipment. Start with the modem pool. In previous sections, it was determined that you would be using the USRobotics Netserver16. In order to set up the modems, a serial cable that came with the modem pool will need to be connected between one of the servers and the modem pool at its serial port on the backside. Log onto the server and install the setup disk that came with the modems. Open the program after installation is complete. There are only a few settings that need to be changed. First, enter the name and address that were determined in the previous section. Now, the modem pool has 16 modems for dial-up connections. In order for the computer dialing in to have Internet access, each modem needs to be set to receive calls and answer in PPP (Point to Point Protocol) mode. The second thing that is necessary is an Internet address. The modem works from an IP stack, that is you assign a stack of free IP addresses (16 in this case) and the modem pool will assign one each time a connection is made. I would recommend that you assign the stack at the high end of your Class C allocation. So enter the upper and lower IP address of XXX.XXX.XXX.240 and XXX.XXX.XXX.255. The modem pool can now be rebooted and is fully configured.

Finally, turn your attention to the router and CSU/DSU. The Phone Company should set up the CSU/DSU when testing the T1. If they do not, make a quick call to their technical support and a technician should be able to walk you through this in minutes. (Different providers require different settings)

The router is last and in this case it is the Cisco 2501. The software is already installed at the factory, so all that is needed is some network information. The router

connects to the serial port of one of the servers just as the modem pool did. The same procedure is followed with the router installation disk. When the program is installed and running, enter the name and IP address of the router that was determined in the previous section. Your T1 supplier will provide the last piece of information. They need to specify a second IP for your router so that it can communicate with the Internet.

The equipment is now setup and should be running smoothly. It is now time to move on to the application installation.

Application Installation:

Begin with the installation of the web server software. This package is called IIS or Internet Information Server. It was most likely installed on the computer at the time that NT was installed. To check, click of the Start menu and look in the programs submenu. If it is not there, click on control panel and click on setup. Here you will be able to install IIS if it is not already done for you.

Click on the IIS icon and it will enter the administration utility. The program is preset so that it needs no configuration to start working. I will just give a brief overview of what IIS does. The WWW server is the device that serves your web pages to whoever is accessing them from the Internet. The directory listed next to it is the directory on your hard drive where you can load your homepage. The default page is the place where you enter the filename of your homepage so that it will open up automatically when someone enters your URL. The ftp server is a device that allows you to place files for public download on your website. The directory listed next to this icon is the physical location of the ftp directory on your hard disk.

These are just the basic functions of the IIS server software. It is capable of hosting several web sites and ftp sites all from the same computer. It is also capable of supporting password protected and secure web pages. If interested in these further capabilities, consult the IIS online help for further information.

The next step is to install the mail server software on the Mail Server. You are going to be working with MetaInfo's Sendmail software package. After initiating the install procedure, you will be asked to enter some network information. The first will be the domain name that your company has registered for this site. (*yourcompany.com*)

Next, you will be asked to enter an administrator account and password for Windows NT so that Sendmail has permission to act as part of the operating system. Finally, you will be asked what kind of security to user for e-mail retrieval. Choose Password File security, and choose a location on the hard drive for the password file. By avoiding NT integrated security, you decrease the chance of someone eaves dropping and getting access to your LAN. Security and account information will now be kept in the password file on the server.

Sendmail is ready to use as soon as user mailboxes are created. An NT administrator can create mailboxes. This is done by editing the Password.txt file and entering the username and a password for the account. This users e-mail address will be *username@yourcompany.com*.

DNS server is the next software package to install. The DNS package is responsible for your LAN, which is the group of 255 IP addresses that was mentioned earlier. The MetaInfo software installs quickly and requires minimal input from the user. When it is done, the only required changes are to the .DB files in the DNS program directory. These files are NAMED.DB, *yourcompany*.DB, REVERSE.DB, LOCAL.DB and CACHE.DB. Each of these files is already setup and only requires that you edit them and replace their information with your network information. It is self-explanatory and will only require the information on IP addresses and names that I have used in the setup section of this paper.

The next step will be to install the news server software on the News server. Insert the software and begin the installation procedure. Once again, you will need an administrator account to install the News server as a service. There are minimal

questions to the setup which will need to be answered by your T1 provider. These questions will involve what type of news connection that you require, how many news groups you want and how often they will update. The connection types are push and pull.

The push type automatically feeds news onto your server any time there is an update on the host news server. This type of connection can fill your hard drive very quickly if not monitored closely. The other type of connection, the pull connection, is one where you designate a time and your server will go out to the provider and update every so often. This is the type of connection that I recommend. It is much easier to manage and is less demanding of your server. For more information, contact your ISP.

The installation is quite simple. The information that needs to be entered is limited to an administrators account and password, and the IP number of the modem pool (XXX.XXX.XXX.5). The modem pool setup will need to be altered to accept the new RADIUS software. The only change to the modem pool will be the assignment of the IP of the server containing the RADIUS software. This can be done by entering the setup software as you did in the modem pool setup. The setup will contain a field for a RADIUS server that will be blank initially. Enter the IP of the server in this location and reboot the modem pool. The RADIUS software is now installed and ready to go.

At this point, all of the software and hardware is installed and configured to get the ISP network up and running. The next step is to power up the router, CSU/DSU, modem pool, and network hub. Then power up the three servers. The network can be checked from any of the three servers by using a ping check. I recommend calling your T1 provider and having them check your router from their location. If there is any configuration problems with the router, they will help you to make corrections. The

same applies for the CSU/DSU. When these two devices are working correctly, you are ready to surf the net. For information on setting up a dial-up client using Windows 95 see Appendix B.

With the Internet becoming a basic tool for employees, companies will see the benefit of providing their employees access to the Internet at all times. However, with the multitude of products and service, a small business would have thought of this as an impossible task. This paper has provided a reasonable step by step guide to make Internet service providing possible. Good luck!

Appendix A

Registering your Domain Name

In the event that your ISP does not take care of the Domain name process for you, we will address is in this section. First, an overview of the Internet naming scheme. There are presently five extensions that you can use for your domain name. They are COM, ORG, NET, GOV and EDU. Most commonly the COM extenuation is used for companies, the org extension for community or not for profit organizations. The net extenuation is usually used for network providing services and the GOV and EDU are reserved for government and educational sites. The first three extensions are not restricted to these uses, however the GOV and EDU extensions are.

You will need to pick a name for your Internet site. Most commonly, the name would be *www.yourcompany.com*, or *www.yourcompany.net*. This is how others are going to locate your site so I recommend something that is easily associated with your site so choose wisely.

The next step is to check and make sure that the name you have chosen is not already in use (Internet addresses must be unique). This can be done by going to the Internic site (Internic is the Internet naming council). The URL for Internic is *www.internic.net*. On the opening page, you will find a link to Registrations Services, click on this link. On the Registration page, you will find a link called WhoIs. Click on this link and enter your proposed URL in the space provided. When you hit enter, you will receive a message as to weather that URL is free or not. If it is not free, you will need to choose another name. Other wise, you can hit the back button on your browser to return to the Registration page.

Now that you have verified the uniqueness of your name, continue by selecting the link to Template Guide. On this page, you will find several links to complete the naming registration process. Click on the Web Version Step by Step link, and you will be presented with the form. The form asks for information such as your chosen domain name, and the IP address of your DNS server. It also asks for a name, phone number and e-mail address for a technical and billing contact. When finished, click the submit button and you are finished.

The registration will cost you $100 and you will be billed by mail or e-mail (you choose in the form). The registration will take about on to three weeks. You will receive your notification via e-mail when it is complete. At that time, your site will be able to be accessed via your URL.

Appendix B

Windows 95 Dial-up Client Installation

Step 1. Installing Dialup Networking

- If dialup networking is already installed on your computer, then you can proceed to Step 2. If you are not sure if dialup networking is installed, double click on the *My Computer Icon* in the top left hand corner of your screen. If there is a folder labeled *Dial-up Networking*, as in the Figure #1, proceed to step two. If not follow these instructions.

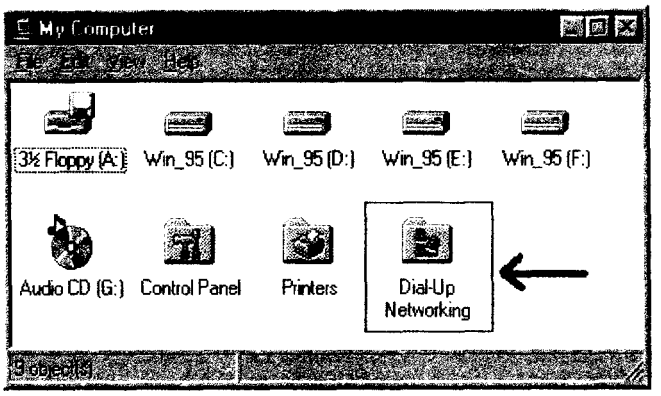


Figure #1

- Begin by double clicking the *Control Panel* icon located in the My Computer window that you just opened up. Double click the *Add/Remove Programs* icon. Next, click on the *Windows Setup* tab located near the top of the newly opened window (Figure #2). On the list of windows components double click on the communications component. Then click once on the box next to the component labeled *dialup networking* (Figure #3) .

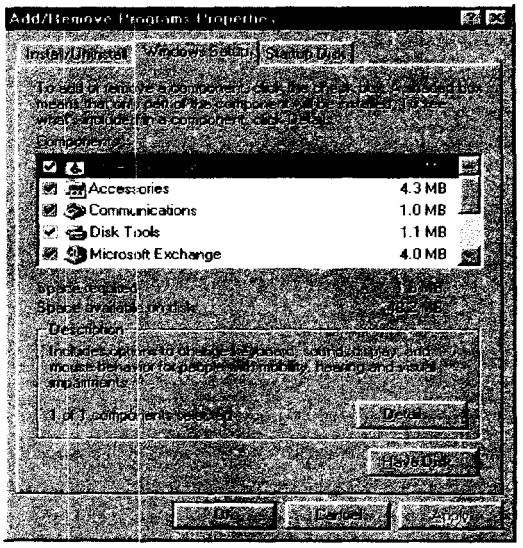


Figure #2

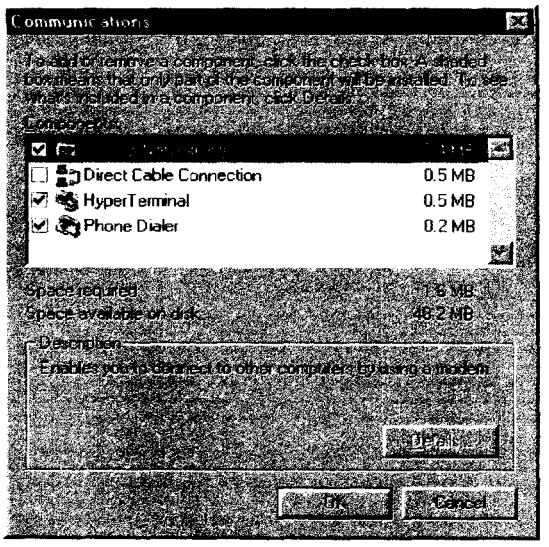


Figure #3

- Click the *OK* button. Then click the *Apply* button. At this point you will be prompted to insert your Windows 95 CD or installation diskette. Insert the disk and click *OK*. When the computer prompts you to restart Windows, click restart now.

Step 2. Setting up your Connection

- Begin by double clicking the *My Computer* icon in the top left hand corner of the screen. Then double click the *Dialup Networking* folder. Double click the *Make New Connection* icon. In the space under *Type a name for the computer you are dialing*, type Internet Connection. Under Select your Modem, make sure that you modem is named here. The computer should already have it listed. Click the *next* button.

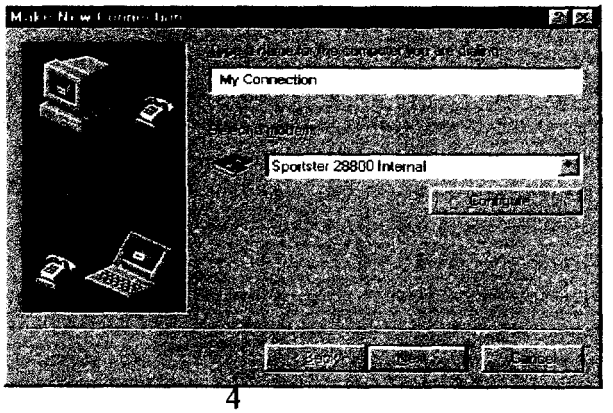


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Figure #4

- Enter the area code and the telephone number for the modem pool(See example in Figure #5). Click the *Next* button. Then click the *Finish* button.

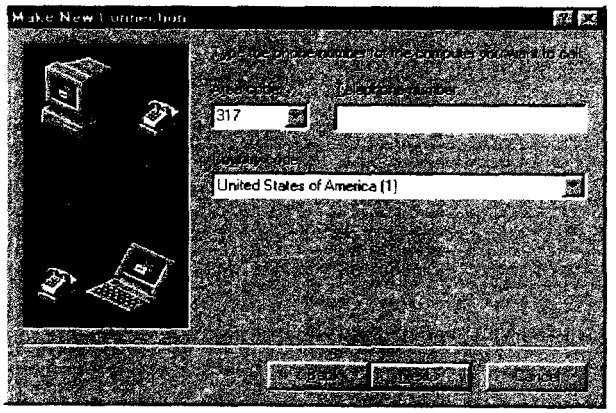


Figure #5

- Click your right mouse button on the *Internet Connection* icon. Click the *properties* item. Click *Server Type*. In the Advanced Options section, make sure that Log on to Network and Enable Software Compression are checked as in Figure #6. In the Allowed Network Protocols section, make sure that TCP/IP is checked. Then click the *TCP/IP Settings* button. Next Click on Specify Name Server Address. In the Primary DNS location enter the following IP address: **XXX.XXX.XXX.3** {It is important that the address be entered exactly as it does appear here.} In the Secondary DNS locations enter the following IP address which is designated by the Regional ISP{Again see the example here in Figure #7.} Then click the *OK* button. Click the *OK* button in the next two windows as well.

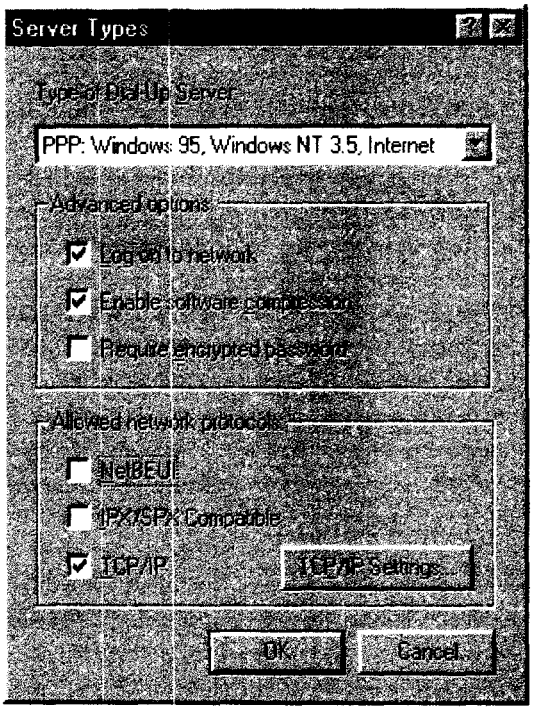


Figure #6

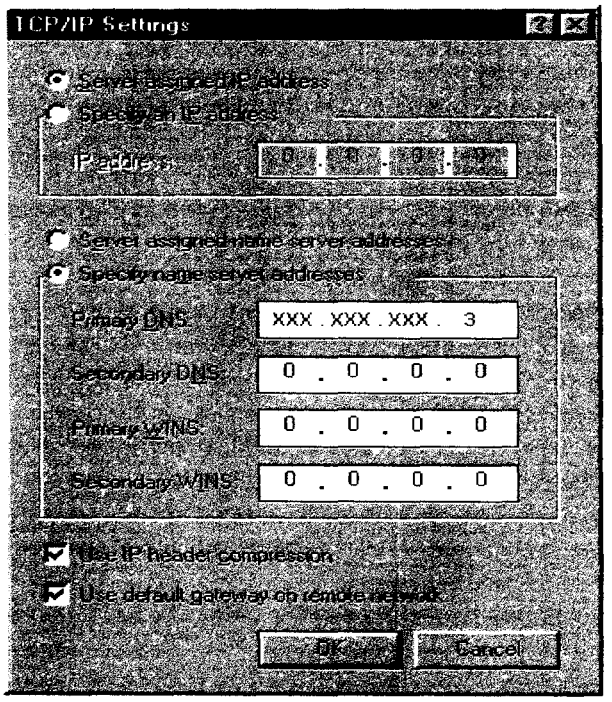


Figure #7

- Your connection is now complete. To make a shortcut icon for your desktop, click on the *Internet Connection* icon and drag it into the desktop. A shortcut window will appear. Click on the *yes* button and your shortcut will appear on the screen. If you have a Browser such as Netscape or Microsoft Internet Explorer, you are ready to surf the net. If not refer to the Step 3 on installing a Browser. To Connect to the Internet click on the *Internet Connection* icon, enter your Username and Password and click the Connect button. Remember that Username and Password are case sensitive.

Step 3. Installing the Microsoft Explorer WWW Browser and E-Mail

- Begin by inserting your Windows 95 CD in the CD-Rom drive. Click on add/remove software and click on the Microsoft Explorer checkbox. When it is finished installing the files, click on the Microsoft Explorer icon on the desktop. The Microsoft Internet installation Wizard will then ask you if you want to install Microsoft Explorer, click yes. It will then place a copy of the licensing agreement on the screen and requires that you press the *I Agree* button to continue. The Wizard will then prompt you to select the folder that the Explorer will be installed into. Double click on Drive C: (See Figure #8) and click *OK*.

- The Installation Wizard will then install the appropriate files and then prompt you to restart your computer. Click *OK* and then click *Start*, *Shutdown* and *Restart the computer*.

- When the computer restarts, double click on *The Internet* icon that now appears on your desktop. The wizard will then display a window titled How to Connect. Click the option that says Connect using my phone line and click the next button (Figure #8) Then select the option that says I already have an account with a different service provider in the next window (Figure #9). Click *Next*.

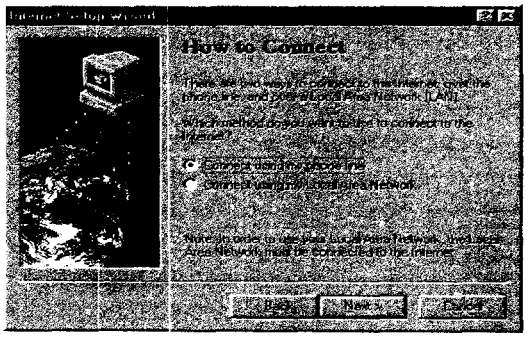


Figure #8

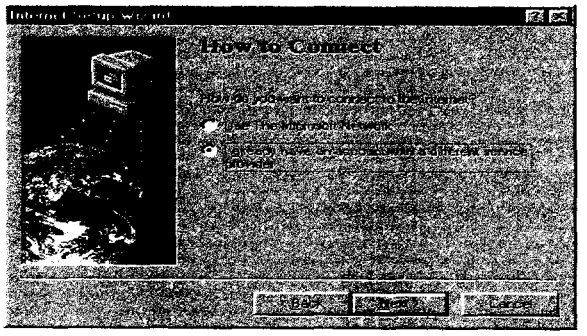


Figure #9

- Next, the setup wizard will open an Internet Mail window. Click *Yes* to use Microsoft Exchange to send and receive Internet Mail, then click *Next* (Figure #10). The next window will say Installing Files. Once again click the *Next* button to proceed (Figure #11).

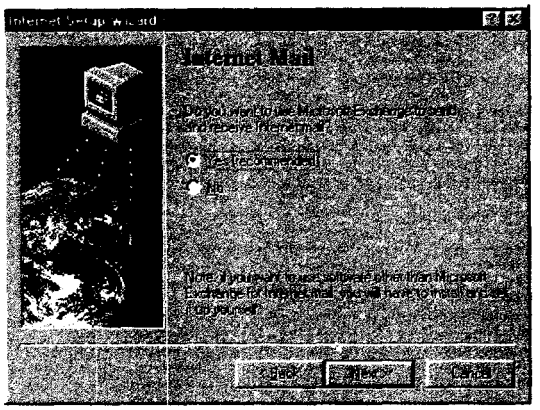


Figure #10

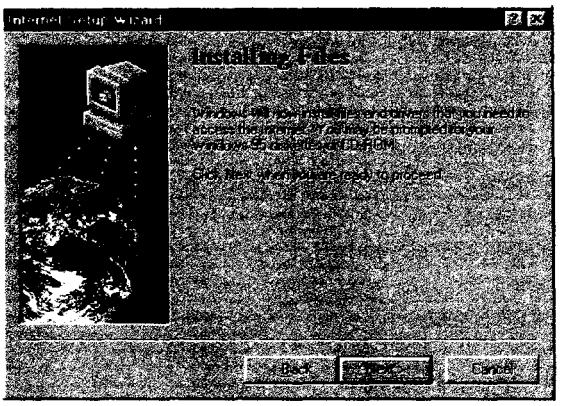


Figure #11

- The setup wizard will then prompt you with a Service Provider Information windows. (Figure #12) In the space provided, you should type *Internet Connection*, and then click *Next*. It will then prompt you for the area code and phone number (Figure #13). Here, enter the phone number to the modem pool.

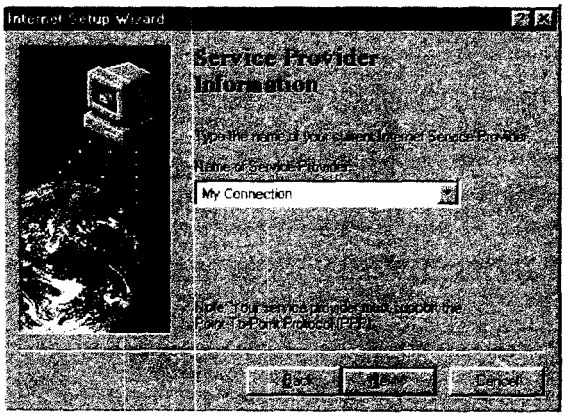


Figure #12

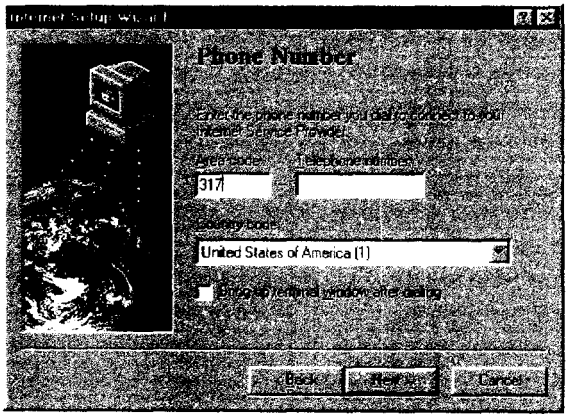
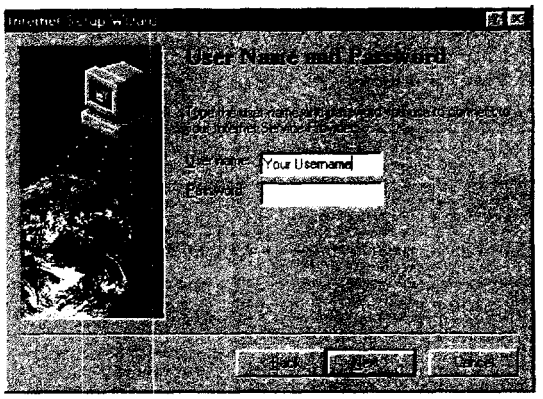


Figure #13

- The wizard will then prompt you to enter your Username and Password. Remember that both of these entries are case sensitive so make sure that they are correct or you will not able to connect. (Figure #14) It will then ask you about IP addressing. Check next to the statement that says that My Internet service provider automatically assigns me one. (Figure #15)



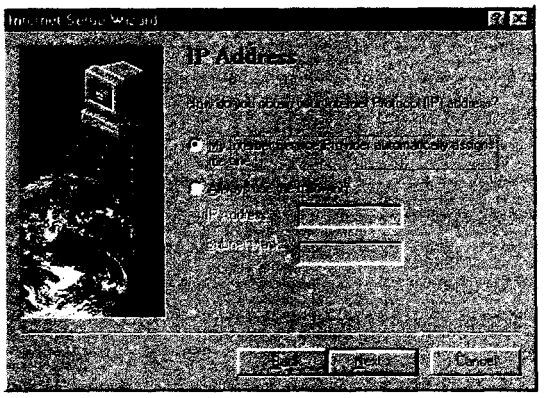
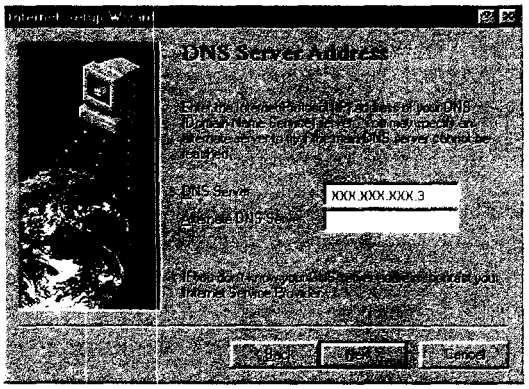


Figure #14 **Figure #15**

- The next step is to make sure that the DNS server Address is correct. The DNS server should be XXX.XXX.XXX.3 and the secondary DNS should be assigned by the regional ISP. The wizard will then prompt you for Internet Mail information. In the space for your e-mail address enter your username followed by @yourcompany.com. In the space designated Internet Mail Server (as in Figure #17), enter MAIL@YOURCOMPANY.COM.



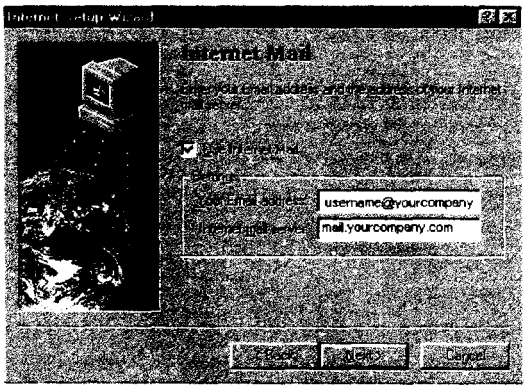


Figure #16 **Figure #17**

- At this point you should come to the end of the setup process. Click *Finish* and your configurations are complete. You are now ready to surf the Net!

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